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EFFECTIVE RADIUS OF A CESIUM ATOM IN GROUND STATE AND FIRST EXCITED STATE

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SUMMARY

The effective radius of neutral cesium in the ground state and in the first excited state has been calculated through the use of Stone's wave functions. The values are 2.98 and 4.12 angstroms for the 6s and 6p states, respectively. An application of the radial information is made to cesium polarizability calculations.

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Author

INTRODUCTION

The size of an isolated atom is of interest in the calculation of various particle interactions. The size can be calculated from an effective dimension judged from the solid crystal structure (ref. 1) or by wave mechanical methods (ref. 2). Stone (ref. 3) has determined the wave functions of cesium, which permit a direct calculation of the effective radius of a cesium atom in its ground state or excited states. In view of the interest in cesium in the field of space power and space propulsion, the effective radius of cesium has been calculated for the ground state (6s) and the first excited state (6p). An example of the application of the cesium radius to polarizability calculations has been made.

ANALYSIS

The radius of a cesium atom may be determined directly (ref. 2) from

$$\bar{r} = \int |R(r)|^2 \, dr \qquad (1)$$

where $\bar{r}$ is the average radius of the outer electron shell for the particular energy state considered, $R(r)$ is the radial part of the function multiplied by r and r is the distance measured from the nucleus. The radial wave functions $R(r)$ for the 6s and 6p states from Stone (ref. 3) have been introduced into equation (1) and numerically integrated on an IBM 7094 computer by a technique using a modification of Simpson's rule. The results are

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